



E/CONF.39/D/13

27 Sept.1962

ORIGINAL : ENGLISH

**UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS**

Agenda Item: D.4.2

Portugal

**APPLICATION OF INSTRUMENTAL ANALYTICAL METHODS
FOR IRON, TIN, LEAD AND ZINC IN CANNED FISH**

By M.R. AGUAS DA SILVA, B.Sc. (Chem.Eng.)
M. Inez SCARES, B.Sc. (F.C.L.)
Chemistry Division,
Instituto Nacional
de Investigação Industrial,
Lisboa

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

APPLICATION OF INSTRUMENTAL ANALYTICAL METHODS
FOR IRON, TIN, LEAD AND ZINC IN CANNED FISH

M. T. Águas da Silva
B. Sc. (Chem. Eng.) (I.S.T.)
M. Inez Soares
B. Sc. (F.C.L.)

Chemistry Division, Instituto Nacional de Investigação
Industrial, Lisboa.

1 - Introduction

This work describes an accurate, sensitive and rapid method for determining the metallic traces (iron, tin, lead and zinc) in olive oil-preserved fish since there exists a close relationship between the cations present in canned fish and its appearance and nutrition value.

In all markets, at home and abroad, canned products must fulfill the following important points - be pleasing to the eye before and after opening of the tins, have no toxic effects and taste good.

The appearance of the tins depends chiefly on the degree of corrosion present. When there is corrosion of the tins, it is advantageous to determine the iron and tin concentrations in the canned fish, and to compare them with the average concentrations in fresh fish. In all food products lead concentrations must be carefully controlled and determined, owing to its high toxicity when absorbed above certain limits. A technique was developed for zinc determination also not because it is toxic nor because it has anything to do with corrosion of the tins, but simply because it imparts a disagreeable metallic taste to food.

The analytical methods developed have some importance because ac-

ceptance standards set limits for metallic traces.

2 - Method

To develop a suitable procedure for the determination of metallic traces, different techniques were studied, tried and modified as needed.

For the determination of iron the spectrophotometric method of 1, 10-phenanthroline⁽¹⁾⁽²⁾ was used, which forms with the ferrous ion, in slightly acid media (pH 5 to 6) a strongly coloured hexacovalent complex of the type $(C_{12}H_8N_2)_3Fe^{++}$. The solutions were prepared taking all usual precautions, and a citrate buffer solution was used to keep the pH at 5.75 for clear and rapid colour development. The optical densities were read at 490 mμ. A calibration graph was plotted with theoretical corrections using standard solutions. The solutions from the canned fish were prepared as indicated under 3. C. and the optical density values were used to determine iron contents from the calibration graph.

The others cations were determined by the polarographic method.

4M ammonium chloride and 1M hydrochloric acid solutions made up the base electrolyte employed for tin determination⁽³⁾⁽⁴⁾⁽⁶⁾. M. Lingane⁽⁵⁾ noticed that in this base electrolyte, tin has an excellent double step with half-wave potentials of -0.25 and -0.52 V vs. S.C.E.. The first step results from the reduction of the $SnCl_6^{-2}$ complex to the $SnCl_4^{-2}$ complex and the second one from the reduction of the $SnCl_4^{-2}$ complex to metal. The characteristics of these steps are well-suited to polarographic determination of this element. Acid media (pH=0.6) were used and the second step only obtained which is suitable for analytical purposes.

For the determination of lead⁽³⁾⁽⁴⁾ 0.1M potassium hydroxide and 0.03 M triethanolamine solutions were used as base electrolyte. An excellent quantitative step is obtained with half-wave potential of -0.83 V vs. S.C.E.. In this electrolyte iron also produced a reduction wave with half-wave potential of -0.95 V vs. S.C.E.. This step is not used for determining the iron concentration, but it can control the values found by the spectrophotometric method.

Zinc⁽³⁾⁽⁴⁾ gives a well-developed step in 1M ammonium chloride, 1M ammonium hydroxide solutions with half-wave potential of -1.25 V vs. S.C.E.. This reduction wave is suitable for the determination of zinc. In this base electrolyte cadmium and nickel produced a well-defined step with half-wave potentials of -0.8 V and -1.05 V vs. S.C.E. respectively. Thus, it is possi-

ble to detect traces of these elements in canned fish.

Linear calibration graphs of step-height against concentration were plotted from the values of polarogram curves of standard solutions of tin, lead and zinc in the respective base electrolytes.

The polarograms of the samples were used in the same way, and from the step-heights were obtained cation concentrations on the calibration graphs. In routine work was employed as reference electrode a mercury-pool a node instead of a saturated calomel electrode.

For the destruction of organic matter were tried out both the ashing method and wet-oxidation by acids ⁽⁷⁾⁽⁸⁾ the latter being adopted because it is quicker and there is no danger of losing some of the inorganic constituents by volatilisation (Sn).

3 - Experimental

a) - Apparatus

Unicam S.P. 500 Spectrophotometer and usual accessories.

Radiometer PO4 Polarograph and usual accessories.

Beckman H2 pH meter.

Polymetrohm 45 pH meter.

Tempunit Thermostat.

b) - Reagents

All the reagents used are of analytical grade. The solutions were prepared with deionised and twice distilled water.

c) - Procedure

After opening of the tins, pH of the fish is measured and then whole of the contents (fish and olive oil) are placed and weighed (after homogenisation) in a tared mortar. Two to three 10 g samples are taken from this homogenised mass into tared Kjeldahl flasks on a hot-plate for nitric attack. Sulphonitric treatment follows. The last traces of organic matter can be destroyed by perchloric acid. Excess sulphuric acid is eliminated by carrying the heat to white fumes while water is added at intervals. The dry residue is taken up with chlorinated water to either 50 or 100 ml as needed.

These solutions are used for determination of the various cations. For iron content 5 ml samples are taken, the pH is adjusted and the normal spectrophotometric treatment follows. For all the others cations 10 ml samples

are taken, heated to near dryness, redissolved in the specific base electrolyte and polarographed. In fig. I there are shown polarograms obtained from tin number 012C.

All tins are given a number and the observed degree of corrosion is noted.

4 - Results and discussion

About 50 tins of canned fish in olive oil, of different makes, different manufacturing dates, different tinplates and different packings, were tested.

Tables 1 and 2 show some of the obtained values for sardines and tunny-fish respectively.

All the fish that was tested had normal organoleptic characters.

Higher contents of iron and tin were observed in the more corroded and older tins, no matter the type of tinplate employed. In soldered tins lead content was higher than in edge-pressed tins.

5 - Conclusions

The method used is rapid, accurate and sensitive. As is obvious, the destruction of organic matter requires more time than the final determinations and, on the average, the tests for series of 5 tins (16 tests per tin) require about 36 hours all inclusive.

The average deviations on the results are of the order of 5%.

Using the described procedures, contents of iron, tin and zinc as low as 0.5 p.p.m., and lead as low as 1 p.p.m., can be determined.

Further work is being carried out along these lines to try and reach more conclusive results on the influence of types of packing (plate used, shape of tins and sealing methods) and the influence of manufacturing procedures and age, as well as other factors, as regards metallic contaminations.

At present some tins of fish canned 20 years ago are being tested.

Also, these techniques have been applied successfully on types of foods other than fish.

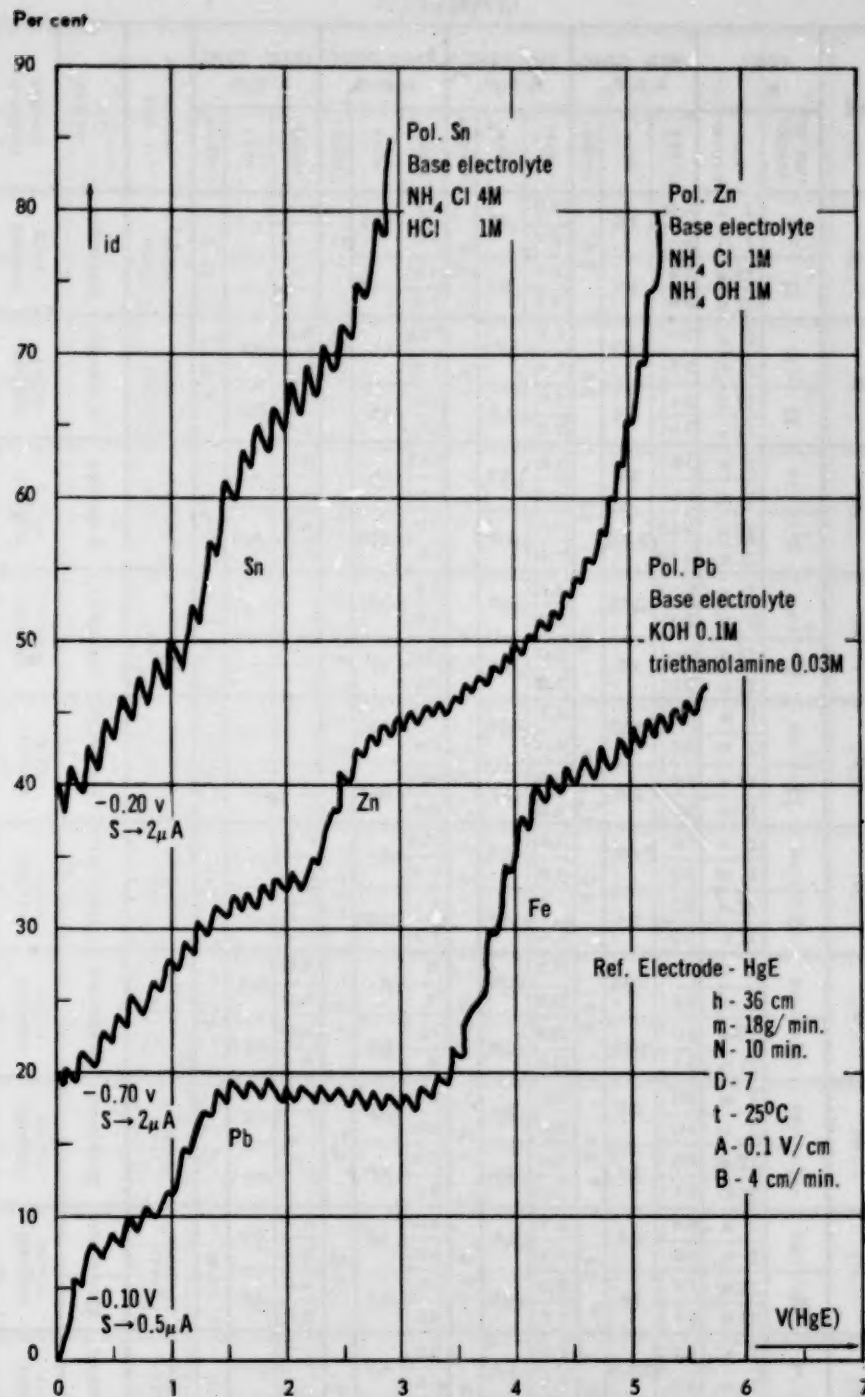


Fig. 1 - Polarograms of sample No. 012 C

TABLE 1

SAMPLE N.	TEST N.		IRON CONC. p. p. m.			TIN CONC. p. p. m.			ZINC CONC. p. p. m.			LEAD CONC. p. p. m.			MANUFACTURE DATE	TIN PATTERN	TINPLATE APPEARANCE	FISH APPEARANCE
	PHER. OF SAMPLE	TEST SAMPLE	VALUES	MEAN	AVERAGE	VALUES	MEAN	AVERAGE	VALUES	MEAN	AVERAGE	VALUES	MEAN	AVERAGE				
012 A	I	I a	42	39	36	2.7	2.7	2.7	13	115	12	—	—	—	—	—	—	—
		I b	36			2.7			10			—						
	II	II a	36	37	36	2.7	2.7	2.7	13	125	12	—	—	—	—	—	—	—
		II b	35			2.7			12			—						
	I	I a	34	35.5	35	1.7	1.75	1.7	12.5	15	1.7	5.8	6.2	6.6	—	—	—	—
		I b	37			1.8			18			6.5						
012 B	II	II a	34	34	35	1.4	1.7	1.7	16	18	1.7	7.2	7.0	6.6	—	—	—	—
		II b	34			2.0			20			6.8						
	I	I a	36	36	35	1.8	1.9	1.7	15.5	14	1.5	4.0	4.9	4.5	—	—	—	—
		I b	34			2.0			12			4.2						
	II	II a	33.5	33.5	35	1.4	1.5	1.7	17	16.5	1.5	4.9	4.8	4.5	—	—	—	—
		II b	33.5			1.6			16			4.7						
013 A	I	I a	24	23.5	23	4.6	4.8	5	7.9	7.5	7.6	—	—	—	—	—	—	—
		I b	23			5.0			7.9			—						
	II	II a	24	23	23	5.0	5.1	5	8.2	7.7	7.6	—	—	—	—	—	—	—
		II b	22			5.2			7.2			—						
	I	I a	31	30.5	29	4.1	4.05	4.1	8.6	8.5	8.7	—	—	—	—	—	—	—
		I b	30			4.0			8.4			—						
013 B	II	II a	26	28	29	4.0	4.1	4.1	9.0	8.9	8.7	—	—	—	—	—	—	—
		II b	30			4.2			8.8			—						
	I	I a	18	19	20	1.5	1.55	1.5	10.7	11	1.1	—	—	—	—	—	—	—
		I b	20			1.6			11			—						
	II	II a	20	21	20	1.5	1.45	1.5	11	10.5	1.1	—	—	—	—	—	—	—
		II b	22			1.4			10			—						
014 A	I	I a	31	28.5	29	0.7	0.75	0.8	9	9	9.3	4.0	4.1	4.1	—	—	—	—
		I b	26			0.8			9			4.2						
	II	II a	30	30.5	29	0.8	0.8	0.8	10	9.5	9.3	4.0	4.05	4.1	—	—	—	—
		II b	31			0.8			9			4.1						
	I	I a	26	28	26	2.4	2.4	2.4	2.2	2.5	2.7	—	—	—	—	—	—	—
		I b	30			2.4			2.8			—						
014 B	II	II a	25	23	26	2.4	2.4	2.4	2.8	3.0	2.7	—	—	—	—	—	—	—
		II b	21			2.4			3.2			—						
	I	I a	26	26	23	1.4	1.4	1.6	50	49	4.8	4.1	3.5	3.6	—	—	—	—
		I b	26			1.3			48			3.0						
	II	II a	17	19	23	2.0	1.85	1.6	45	47	4.8	4.0	3.8	3.6	—	—	—	—
		II b	21			1.7			48			3.6						
018 A	I	I a	27	24.5	25	1.3	1.2	1.2	50	49	4.8	—	—	—	—	—	—	—
		I b	22			1.1			48			—						
	II	II a	26	26	25	1.1	1.1	1.2	46	47	4.8	—	—	—	—	—	—	—
		II b	26			1.1			48			—						
	I	I a	27	24.5	25	1.3	1.2	1.2	50	49	4.8	—	—	—	—	—	—	—
		I b	22			1.1			48			—						
018 B	II	II a	26	26	25	1.1	1.1	1.2	46	47	4.8	—	—	—	—	—	—	—
		II b	26			1.1			48			—						
	I	I a	27	24.5	25	1.3	1.2	1.2	50	49	4.8	—	—	—	—	—	—	—
		I b	22			1.1			48			—						
	II	II a	26	26	25	1.1	1.1	1.2	46	47	4.8	—	—	—	—	—	—	—
		II b	26			1.1			48			—						

TABLE 2

SAMPLE N.	TEST N.		IRON CONC. p. p. m.			TIN CONC. p. p. m.			ZINC CONC. p. p. m.			LEAD CONC. p. p. m.			MANUFACTURE DATE	TIN PATTERN	TINPLATE APPEARANCE	FISH APPEARANCE				
	PREP. OF SAMPLE	TEST SAMPLE	VALUES	MEAN	AVERAGE	VALUES	MEAN	AVERAGE	VALUES	MEAN	AVERAGE	VALUES	MEAN	AVERAGE								
029 A	I	I a	27	26	25	82	7.9	7.7	1.2	1.3	1.3			1	AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL				
		I b	25			76			1.4													
	II	II a	24	235	23	6.1	7.4	6.7	1.2	1.2	1.2			1					AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL
		II b	23			8.6			1.2													
029 B	I	I a	27	26	23	84	8.3	8.7	1.3	1.25	1.2			1	AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL				
		I b	25			82			1.2													
	II	II a	19	20	20	90	9.0	9.0	1.1	1.15	1.2			1					AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL
		II b	21			9.0			1.2													
029 C	I	I a	25	245	24	80	8.5	1.1	1.2	1.2	1.2			1	AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL				
		I b	24			90			1.2													
	II	II a	23	228	22	120	125	125	1.1	1.15	1.2			1					AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL
		II b	225			130			1.2													
029 D	I	I a	24	235	24	8.5	8.5	7.8	1.6	1.6	1.6			1	AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL				
		I b	23			8.5			1.6													
	II	II a	23	24	24	7.0	7.1	7.1	1.5	1.5	1.5			1					AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL
		II b	25			7.2			1.5													
029 E	I	I a	28	275	26	5.0	4.9	4.9	1.7	1.6	1.7			1	AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL				
		I b	27			4.8			1.5													
	II	II a	27	28	28	4.9	4.8	4.8	1.8	1.7	1.7			1					AUGUST 1961	DIPPED PLATE	LITTLE CORRODED	NORMAL
		II b	29			4.7			1.6													
026 A	I	I a	24	285	28	1.3	1.25	1.2	1.26	1.13	1.13			1	OCTOBER 1961	BLACKPLATE	LITTLE CORRODED	NORMAL				
		I b	33			1.2			1.02													
	II	II a	31	275	27	1.0	1.05	1.0	1.12	1.13	1.13			1					OCTOBER 1961	BLACKPLATE	LITTLE CORRODED	NORMAL
		II b	24			1.1			1.14													
026 B	I	I a	18	20	20	1.2	1.1	1.2	3.0	3.1	3.2			1	OCTOBER 1961	BLACKPLATE	LITTLE CORRODED	NORMAL				
		I b	22			1.0			3.2													
	II	II a	29	27	27	1.2	1.2	1.2	3.4	3.3	3.2			1					OCTOBER 1961	BLACKPLATE	LITTLE CORRODED	NORMAL
		II b	25			1.2			3.2													
026 C	I	I a	24	225	24	1.9	1.8	1.7	4.7	5.65	5.2			1	OCTOBER 1961	BLACKPLATE	LITTLE CORRODED	NORMAL				
		I b	21			1.7			6.6													
	II	II a	24	25	25	1.3	1.5	1.5	7.1	6.65	6.2			1					OCTOBER 1961	BLACKPLATE	LITTLE CORRODED	NORMAL
		II b	26			1.7			6.2													
023 A	I	I a	12	135	14	2.0	2.05	2	5.6	5.35	5.6			1	MARCH 1962	BLACKPLATE	LITTLE CORRODED	NORMAL				
		I b	15			2.1			5.1													
	II	II a	16	145	14	2.0	2.0	2.1	6.2	5.9	5.1			1					MARCH 1962	BLACKPLATE	LITTLE CORRODED	NORMAL
		II b	13			2.0			5.6													
023 B	I	I a	14	12	13	2.1	2.1	2.1	5.4	5.3	5.2			1	MARCH 1962	BLACKPLATE	LITTLE CORRODED	NORMAL				
		I b	10			2.1			5.2													
	II	II a	14	135	13	2.1	2.1	2.1	5.1	5.1	5.1			1					MARCH 1962	BLACKPLATE	LITTLE CORRODED	NORMAL
		II b	13			2.1			5.1													

6 - References

- (1) - Sandell, E. B., Colorimetric Determination of Traces of Metals, Interscience Publishers, Inc., New York (1959).
- (2) - Snell, F., Snell, C. T. and Snell, C. A., Colorimetric Methods of Analysis, D. Van Nostrand Company, Inc., New York (1959), vol. II A.
- (3) - Kolthoff, I. M. and Lingane, J. J., Polarography, Interscience Publishers, New York (1959), vol. II.
- (4) - Milner, G. W. C., The Principles and Applications of Polarography and other Electroanalytical Processes, Longmans, Green And Co, London (1958).
- (5) - Lingane, J. J., J. Amer. Chem. Soc., 67, 919 (1945).
- (6) - Godar, E. M. and Alexander, O. R., Ind. Eng. Chem., Anal. Ed., 18, 681 (1946).
- (7) - Official Methods of Analysis of the Association of Official Agricultural Chemists, ninth edition (1960), pg. 308.
- (8) - Methods for the Destruction of Organic Matter, Analyst, 85, 643 (1960)



**UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS**

E/CONF.39/D/13

SUMMARY

27 Sept.1962

ORIGINAL : ENGLISH

SUMMARY

Agenda Item: D.4.2

Portugal

**APPLICATION OF INSTRUMENTAL ANALYTICAL METHODS
FOR IRON, TIN, LEAD AND ZINC IN CANNED FISH**

By **M. T. ÁGUAS DA SILVA,**
B. Sc. (Chem. Eng.),
and **INEZ SOARES**
B. Sc. (F. C. L.),
Chemistry Division,
Instituto Nacional de Investigação Industrial,
Lisboa

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

APPLICATION OF INSTRUMENTAL ANALYTICAL METHODS

FOR IRON, TIN, LEAD AND ZINC IN CANNED FISH

M. T. Águas da Silva
B. Sc. (Chem. Eng.) (I.S.T.)

M. Inez Soares
B. Sc. (F.C.L.)

Chemistry Division, Instituto Nacional de Investigação
Industrial, Lisboa.

SUMMARY

Since the determination of metallic traces in canned fish is a problem of great practical importance, rapid and accurate analytical techniques are needed which were developed and tested, as will be described.

So far, methods for determining iron, tin, lead and zinc, have been developed, preference having been given these cations because of the following:

- iron and tin since their presence in canned goods clearly indicates if any corrosion of the tins occurred,
- lead because it is toxic if present in food above certain limits and,
- zinc by virtue of the disagreeable metallic taste it imparts to food.

Spectrophotometric and polarographic techniques were used, the former for iron only and the latter for the other cations.

Iron was determined by means of 1,10-phenanthroline at 490 m μ .

Tin was determined in a base electrolyte consisting of 4M ammonium chloride and 1M hydrochloric acid.

For lead determination 0.1M potassium hydroxide and 0.03M triethanolamine solutions were used as base electrolyte.

For zinc the base electrolyte was 1M ammonium chloride, 1M ammonium hydroxide solutions.

Organic matter was destroyed by sulphonitric treatment followed by perchloric oxidation, with final residue solution in dilute hydrochloric acid.

The average deviation on the results are of the order of 5%.

Series of the tins of canned sardine and tunny-fish from different makers, in different types of packing and with different manufacturing dates, were tested.

May 1962



E/CONF.39/D/14

27 Sept.1962

ORIGINAL : ENGLISH

**UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS**

Agenda Item: D.2.3

India

**MODERNIZATION OF SMALL SCALE INDUSTRY
IN INDIA**

**By P. G. ALEXANDER,
Development Commissioner,
Small Scale Industries,
Government of India**

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

D.2.3. MODERNISATION OF SMALL SCALE INDUSTRY IN INDIA

P. G. Alexander
(DEVELOPMENT COMMISSIONER,
Small Scale Industries,
GOVERNMENT OF INDIA.)

...

Definition and concept of small industry:

1. The term 'small industries' comprises different groups of industry, each having distinctive characteristics and requiring specialised attention. All-India Boards/Commissions have been set up for the development of handlooms, silk, coir, handicrafts and khadi and village industries. Industries not covered by these organisations have been grouped into what are known as small scale industries. As the name implies, these are industries with comparatively small capital outlay. According to the working definition adopted by the Government, small scale industries include all industrial units with a capital investment of not more than Rs.500,000/-. Capital investment here refers to value of fixed assets only, i.e. value of land, building, machinery and equipment. There is no limit, according to the definition, on the working capital or the number of workers employed. A few typical examples of small scale industries in India are: bicycles and parts, sewing machines and parts, small machine tools, domestic electrical appliances, cutlery, toys, footwear, leather goods, etc.

2. There is no rigid demarcation of spheres between the small and village industries on the one side, or between small and medium industries on the other. Perhaps a distinction between small and village industries can be drawn on the basis of the level of mechanisation. Small scale industries, by and large, can be said to be industries following modern techniques, methods and tools of production, while village or cottage industries follow the traditional. The distinction between small and medium or large industries is one largely based on the size of the plant or the scale of operation. The items of manufacture are very often common, but the main policy of the development programmes for small scale industries is to encourage small industries in fields where economies work in their favour. Where small industries can be

established with equal efficiency as on large scale, common production programmes have been worked out so that small units are not squeezed out by unfair sales policies or other such methods of competition.

3. Development of small-scale industries has been assigned high priority and importance in the development programmes in India. Several important social and economic objectives are sought to be achieved by the promotion of these industries. They help in providing large-scale employment at relatively small capital cost. They are expected to meet a substantial part of the increased demand for consumer goods and simple producer goods in the country. They help in mobilising resources and skill which might otherwise remain unutilised. They facilitate decentralised industrial development and ensure a more equitable distribution of the national income. In order to enable the small industries to play this vital role in the national economy, it is important that they should be assisted to develop into strong and healthy units. The main problem of small industries in India today is the problem of their weakness. This weakness is caused by a variety of factors the chief among them being lack of technical knowledge, inadequacy of capital and inefficient methods of management and marketing. The main objective of the development programmes for small scale industries in India is to help the small industrialists to overcome these handicaps and difficulties and to acquire sufficient competitive strength and vitality to stand on their own.

Modernisation: main problems:-

4. Modernisation of small scale industries in India as in all developing countries presents several difficult problems. The chief among them is the danger of technological unemployment. Modernisation need not be equated with mechanisation as it involves not only introduction of modern machinery and equipment, but also modern methods of management, marketing, etc. But invariably modernisation will lead to mechanisation and care has to be taken to ensure that mechanisation does not cause serious disturbances in the social order. The degree and pace of mechanisation have to be gradual in all developing countries so as to avoid the stresses and strains of sudden changes. A danger to be guarded against is the tendency to go in for modernisation at all costs. What is important is the rapid development of small-scale industries, and the degree and scope of modernisation have to be determined by its contribution to development.

5. The main difficulties and handicaps in achieving rapid modernisation of small scale industries may be

listed as follows:-

- (a) Lack of knowledge on the techniques and methods of modernisation;
- (b) Difficulties in securing modern machinery and equipment;
- (c) Shortage of raw materials, parts and components of the right standard and specifications;
- (d) Shortage of trained workmen, technicians and managers;
- (e) Inadequate credit facilities;
- (f) Difficulties in securing good factory accommodation;
- (g) Shortage of electricity and other sources of power; and
- (h) Difficulties in Marketing.

6. Some of these problems are applicable not only to small scale industries, but also to medium and large industries in India. But these problems are particularly acute in the case of small scale industries. The steps taken by the Government and other such agencies to help the small industrialists to overcome these difficulties and accelerate the pace of modernisation and development are outlined briefly in the following paragraphs.

Modernisation -- role of extension agencies:-

7. Lack of knowledge of modern tools, methods of production and management has been the main handicap for small industries in India. The small industrialists with their limited resources cannot afford to have consultants or highly qualified engineers or experts. The Government have, therefore, stepped in to provide this assistance to small industrialists, and have established the Central Small Industries Organisation (C.S.I.O.) for this purpose. The CSIO consists of an Headquarters office for co-ordination and sixteen Small Industries Service Institutes, four Branch Institutes and over sixty Extension Centres spread all over the country. The Industrial Extension Service is intended to solve the technological problems of small scale industries and help them in increasing their productivity. The Institutes are manned by officers

with qualifications and experience in different branches of technology, business management, industrial designing, etc. The technical assistance programme includes advice on selection of industries which is followed by guidance in planning of production, selection of machinery and raw materials, factory lay-out, designing of tools, jigs and fixtures, etc. Even after the units have gone into production, the field officers of the Small Industries Service Institutes visit the factories and assist the small industrialists in removing manufacturing defects and effecting economies in fuel and raw materials and increasing productivity. The technical staff also renders services like repair of machinery, testing and chemical analysis. The Institutes and Extension Centres are located in areas where small units are already concentrated or where there is potential for small industries growth. Workshops attached to the Institutes are equipped with machinery for providing certain common service facilities which an average small unit cannot afford to own.

8. The Small Industries Service Institutes have also a number of mobile vans to go round the rural areas in order to demonstrate the use of modern machinery and equipment by various operations and processes. These vans are fitted with up-to-date tools and machines in trades like blacksmithy, carpentry, shoe-making, leather goods, electroplating, electric wiring, winding, etc. The artisans are allowed to operate the machines mounted on the vans and to repair their tools. The staff attached to the mobile workshops give information about the specifications, and sources of availability of machines and processes of modern production.

9. Another important programme of the Central Small Industries Organisation is to assist the small industrialists to improve the designs of their products. This programme aims at improving product designs of various trades by studying consumer tastes, functional values, aesthetic appeal and the manufacturing capacity of the producer. Product designs are prepared at the initiative of the designers themselves or at the instance of small industrialists who are free to approach them for this purpose. Every detail is worked out and finally a scale model, drawing or a prototype is prepared which is offered to the industrialists for adoption.

10. Guidance to small industrialists in the choice of items for manufacture and for proper location is provided by the CSIO on the basis of extensive economic investigations and surveys. The Economic Investigation Division of the CSIO conduct surveys to study the

economies of selected industries with a view to assessing their present position and future prospects and suggest steps to be taken for their rational development. They also undertake Area Surveys to find out the level of industrial activities in different areas and their potentiality for development based on the availability of human resources, raw materials, power, transport, consumption pattern and other such factors. The reports on these surveys provide factual information and analysis of the existing and potential industries and help the authorities interested in the development of these areas to chalk out a programme of industrial development. To assist individual manufacturers, market research is undertaken by the Economic Investigation Division by which useful market information like consumer demand, consumer preferences, etc. is gathered and furnished to the manufacturers. The Economic Investigation Division has also taken up the preparation of 'Industries Prospects Sheets' on a large number of industries. These 'prospects sheets' provide information on the technical feasibility, competitiveness and size of investment for an economic unit and the supply and demand position. These surveys act as a guide to entrepreneurs in choosing the right lines of manufacture.

11. One of the important objectives of the development programmes for small scale industries in India is the extension of small industries to economically backward and rural areas. It was found that the impact of the small industries development programme in the early years had been confined to big cities and towns and that the backward and rural areas had not been very much influenced by this programme. It was, therefore, decided to launch intensive development campaigns in backward and rural areas which offered potentialities for development of small scale industries. The main objective of the campaigns is to create a climate conducive to the development of small scale industries by intensive instruction and information about the scope for small industries and the use of modern machinery and methods of production. The campaign is conducted in different stages. In the first phase, a quick survey of the industrial potentialities of the district is undertaken. This is followed by a contact programme. Officers of the CSIO, the State Government and other such agencies and prominent non-official leaders tour the area, contact the prospective entrepreneurs and explain to them the prospects of particular industries and the assistance available from various agencies. The officers in charge of the programme visit the area again and do the follow-up action on the contacts earlier established. Specific guidance is provided in the

selection of industries, machinery and equipment, location of factory, training of workers and sources from which assistance can be obtained. In the case of existing units, the extension staff gives advice on replacement of outmoded machinery, economic use of raw materials and improved techniques and methods of production. Thus the message of modernisation and improvement is taken to the doors of the people in backward and rural areas instead of waiting for them to approach the extension agencies on their own initiative.

Machinery and equipment:-

12. Introduction of modern machinery and equipment is one of the basic postulates for development. The main task of the Industrial Extension Service agencies is to create an awareness among the small entrepreneurs of the need for modern machinery and equipment. Small industrialists can obtain assistance freely from the extension agencies regarding the right type of machinery and equipment to be used by them, but they often find it difficult to follow-up this advice because of the inadequacy of capital or non-availability of machines from indigenous sources. In order to enable the small industrialists to overcome this difficulty the Government have introduced a scheme of supplying machinery on hire-purchase terms. This scheme is operated by the National Small Industries Corporation, which is a Government undertaking, with the assistance of the CSIO and the State Departments of Industries. Normally, a small industrialist has to pay only 20% of the value of the machines required by him as initial deposit; the balance is to be paid in instalments spread over a period of seven years. The Corporation since its inception has received applications from industrialists for supply of over 18,000 machines valued at about Rs.190 million. Over 6,500 machines valued at Rs.83 million have already been supplied to small industrialists. A special advantage of this scheme is that in addition to being a scheme of financial assistance, it facilitates the introduction of machinery and equipment of standard quality. The National Small Industries Corporation supplies the machinery as suggested or demanded by the applicants, but invariably care is taken to ensure that the applicants get machinery and equipment of standard quality even if the price is comparatively higher. The scheme thus helps in the promotion of a consciousness for standards and quality which is very important for development.

13. A major difficulty faced in the operation of the scheme of supply of machinery on hire-purchase basis

has been the delay in getting machinery and equipment of standard quality from the manufacturers. The indigenous machine building industry in India is not able to cope with the growing demand for new machines and tools created by the tempo of development. In many cases, particularly in the case of special purpose machines, there is no indigenous production and orders have to be placed with foreign manufacturers. The negotiations for placement of orders and the long delivery period demanded by manufacturers cause delays of eighteen to twenty months in many cases and create difficulties to a small entrepreneur in the matter of planning his production programme. Shortage of foreign exchange has aggravated the difficulties of the small entrepreneurs. They have to face difficulties and delays not only in securing machinery and equipment, but to a much larger extent in getting raw materials, components and parts. During the past few years, several new small industries have been set up which require import of raw materials and components, and progress has thus brought in its wake the problem of shortages. Several small units find it difficult to get raw materials of the right quality and for their full requirements and this has no doubt retarded the pace of modernisation. The Industrial Extension Service agencies are constantly endeavouring to steer development of new industries to fields where there will be no shortages of raw materials. They are also encouraging diversion of existing units from fields where shortages are chronic to easier fields. These measures are unavoidable and even necessary to maintain the tempo of development in the context of foreign exchange shortages.

Training:-

14. Training of personnel for and from small scale industries is quite important in any programme of modernisation. Introduction of new machinery and new process and techniques of production has brought into focus the great shortage of trained personnel at all levels. To enable the industry to absorb the technological developments quickly, the Government have been encouraging foreign collaboration in special fields. Several small industries have already been established with foreign collaboration and Indian technicians get the training and know-how required for operation of the industries from the foreign collaborators. A few examples of such foreign collaboration in small industry are water meters, electronic instruments, textile accessories, razor blades, automobile accessories, etc.

15. Arrangements for training through foreign

collaboration or by foreign agencies can meet only a fraction of the problem. Training is required for personnel at all levels -- managers, supervisors and workers, and facilities have to be organised to suit their specific requirements, if modernisation is to be quick and effective.

16. The special characteristic of a small industry is that it has no specialisation in management. The manager or proprietor is generally responsible for production, marketing, financing and all other aspects of the undertaking. The major problem in training such people is to convince them that they need and can benefit from training. Even if they are convinced, it becomes difficult for them to leave their business to attend a regular training course. Formal management courses of the type given in Universities will not be suitable for managers of small firms. Therefore, a special course of training tailored to meet their requirements and to suit their convenience, has to be organised. The Small Industries Service Institutes have organised such courses of training for managers of small businesses during evening hours. The subjects covered in these courses include principles and practices of management, factory organisation, marketing and publicity, legal aspects, financial and cost accounting, etc. Intensive courses are conducted in specific subjects like quality control, work-study, production planning and control, management accounting, etc.

17. Training for workers drawn from small industries is provided by the Small Industries Service Institutes and Extension Centres. The main objective of this training is to make a worker more skilled in his own trade. The workers who come for training generally do not have any educational qualifications. Nevertheless they have shown a remarkable capacity to absorb quickly modern techniques and processes of production. Some of the subjects in which training is given to workers by the CSIO are machine shop practice, tool room, heat-treatment, electroplating, footwear, glass blowing, etc.

18. As part of the training programme, the Central Small Industries Organisation also arranges study-ou,-observation visits of small industrialists and workers to selected large and small-scale units. These visits give them opportunities to observe modern techniques of production and management.

19. As a special step for improving the technological skills of small entrepreneurs, the Government have established three major Proto-type Production-cum-Training

Centres with the assistance of foreign Governments, one in Okhla (near Delhi) with the assistance of the Government of West Germany, another at Rajkot with the assistance of the Agency for International Development of the United States and the third at Howrah (Calcutta) with the help of the Government of Japan. The main objective of these Centres is to develop prototype of machines and equipment and pass them on to small-scale industrial units for commercial exploitation. These Centres also provide advanced training to skilled workers and supervisors drawn from small-scale industries.

20. Training of extension staff is as important as training of managers, supervisors and workers from industry in any planned scheme of development of small industries. The extension staff function as the agencies for the modernisation process and it is necessary that they should be up-to-date in their own skills and proficient in communicating them to others. In view of the important role played by the Industrial Extension Service agencies in the different programmes of assistance to small industrialists, the need for this is greater in India. A major difficulty has been in getting technical staff of the required qualifications and experience to man the Industrial Extension Service. The shortage of technical staff is a general problem in all developing countries; but the problem is specially acute in the case of technical personnel required for Extension Service. The remedy for this problem is to provide continuous training to those who have been recruited and equip them for the tasks expected of them. The Government of India have recognised the need for such intensive training and have been deputing the staff of the CSIO to selected large industrial units and training institutions in India and also in foreign countries. An Industrial Extension Training Institute has been recently established at Hyderabad by the Government of India to provide special training in the techniques of industrial extension service to the staff of the CSIO and of the State Departments of Industries.

Credit:-

21. The pace of modernisation in the field of small-scale industries has been very much hampered by difficulties in getting credit on easy terms. Small entrepreneurs invariably start their business with extremely limited capital scraped from their own resources or borrowed at exorbitant rates of interest. Even if they know how to improve their production, they often fail in this task because of their inability to raise capital for acquiring

good factory accommodation or new machinery and equipment or for recurring expenses. Banks and other institutional agencies of credit find these units ineligible for lending and they are therefore thrown back on the mercies of money-lenders. Small industrialists could obtain loans from the State Governments for capital and working capital requirements, but the terms and conditions were so rigid that these loans were not of real assistance to the needy entrepreneurs. One of the earliest steps taken for the development of small-scale industries was to liberalise the terms and conditions under which loans could be advanced to them. Now loans upto Rs.1,000 can be given by the State Governments on personal bonds without sureties, upto Rs.5,000 against two personal sureties, and above Rs.5,000 at 75% of the security offered. These loans are repayable in easy instalments spread over a period of ten years.

22. The programme of credit assistance to small scale industries by the Government is intended only to supplement the efforts of institutional agencies like the commercial and co-operative banks, the State Finance Corporations, the State Bank of India, etc. The State Bank of India has already taken the initiative in providing credit on easy terms to small scale units through its branches spread all over the country. Other banking institutions are also now coming to field. Recently, a credit guarantee scheme has been introduced by the Reserve Bank of India to ensure a degree of protection to the lending institutions against possible losses in respect of their advances to small industrialists.

Factory accommodation:-

23. Modernisation often requires alterations and improvements in factory space. Absence of good factory accommodation has been a serious handicap for the development of small industries. Even if small industrialists could raise the capital to build a factory, formalities of acquiring a suitable land, getting the plans approved by the local authorities, securing supply of water and power and other such requirements presented serious difficulties to them. In order to meet this difficulty, the Government initiated the programme of Industrial Estates in 1955, by which factory accommodation could be made available to small entrepreneurs at reasonable cost. An Industrial Estate is a group of factories constructed on an economic scale in suitable sites with facilities of water, power, transport, etc. and provided with special arrangements for technical guidance and common service

facilities. The Estate combines in itself some of the important schemes of assistance to small industries, and provides an ideal tool for integrated development. The better conditions of work in the factories increase the productivity of the workers. It provides opportunities for small units to observe the working of each other and benefit from such experience. In many cases it helps small units to make use of each other's services and goods and thus effect economies in production. It facilitates organisation of common service facilities like common arrangements for transport, purchase of raw materials and publicity for sale of finished goods. By the end of the Third Plan period, over 500 Industrial Estates sponsored by the Government will be functioning in different parts of the country, besides several others set up by private agencies.

Electric power:-

24. Introduction of modern technology involves use of power, but non-availability of power has been a major factor retarding the progress in this field. Out of the 5,71,000 villages and towns in India, hardly 23,000 had electric power by the end of the Second Plan. Even by the end of the Third Plan their number will not go beyond 43,000. This limits the scope of extension of small industries to rural and under-developed areas. Even where power is available, uninterrupted supply at rates favourable to small consumers is necessary to accelerate the pace of modernisation. In India power rates vary from place to place. In order to help the small industrialists to get power at economic rates, the Government have introduced a scheme of subsidising the cost of power.

Limitation of markets:-

25. An important limiting factor to modernisation is the size of the market. Markets for small industries' products are essentially local or regional. But in some cases they can extend to the entire country. In India small industry is a free sector and requires no licensing as is the case with large scale enterprises. This sometimes results in over-crowding and unwanted competition. In a sheltered market small producers are able to sell easily but this situation need not persist. Small industrialists generally concentrate on production and neglect marketing.

26. Modernisation calls for quality consciousness among buyers and wider market. Expanded marketing requires

selling arrangements, different from those to which the small industry is used to when its markets are narrow and limited. Brands, advertising and product display have to be used to serve larger territories effectively. Better supervision of sales becomes important.

27. In order to solve some of these problems and to provide an assured market the CSIO has been laying increasing emphasis on the development of sub-contracting system or the growth of ancillary units. The sub-contracting system is not yet fully developed in the country. A few large scale industries -- public and private -- have shown their eagerness to develop sub-contracting relationship with smaller units which include giving them technical know-how, drawings, designs and even raw materials. The Government have been giving special assistance and encouragement for Industrial Units functioning as ancillaries to large industries and it is hoped that this pattern of development will help in accelerating the pace of modernisation.

28. Another way in which the size of the market is assured to small units is by enlisting them for quoting against orders for Government stores purchase. The Union Government is the largest single buyer of the country and therefore whatever it can buy on a regular basis is a positive encouragement to small producers. A scheme has been devised under which small manufacturers are entitled to a price preference upto 15% over those quoted by large industries. Twenty-seven items of stores usually required by the Govt. have been reserved for purchases from small producers. This has resulted in increasing purchases being made from small industries and substantially contributed to their strength.

the first of these is the fact that the
second of these is the fact that the
third of these is the fact that the
fourth of these is the fact that the
fifth of these is the fact that the

sixth of these is the fact that the
seventh of these is the fact that the
eighth of these is the fact that the
ninth of these is the fact that the
tenth of these is the fact that the

eleventh of these is the fact that the
twelfth of these is the fact that the
thirteenth of these is the fact that the
fourteenth of these is the fact that the
fifteenth of these is the fact that the

sixteenth of these is the fact that the
seventeenth of these is the fact that the
eighteenth of these is the fact that the
nineteenth of these is the fact that the
twentieth of these is the fact that the



UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

E/CONF.39/D/14

SUMMARY

26 Sept.1962

ORIGINAL : ENGLISH

SUMMARY

Agenda Item: D. 2. 3

India

MODERNISATION OF SMALL SCALE INDUSTRY
IN INDIA

By P. C. ALEXANDER,
Development Commissioner,
Small Scale Industries,
Government of India

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

S U M M A R Y

D.2.3. MODERNISATION OF SMALL SCALE INDUSTRY IN INDIA.

**P. C. Alexander,
(Development Commissioner,
Small Scale Industries,
Government of India.)**

In India a small scale industry is defined as an industry with capital investment of not more than Rs.500,000.

Development of small scale industries has been assigned high priority and importance in the development programmes of India. The main problem of small industries is the problem of their weakness arising from lack of technical knowledge, inadequacy of capital, and inefficient methods of management and marketing. The development programme aims at helping the small industrialists to overcome these handicaps.

An important problem to be faced in modernisation is the danger of technological unemployment. The degree and pace of mechanisation have to be gradual so as to avoid the stresses and strains of sudden changes.

The main difficulties and handicaps in achieving rapid modernisation of small scale industries are:-

- (a) Lack of knowledge on the techniques and methods of modernisation;
- (b) Difficulties in securing modern machinery and equipment;
- (c) Shortage of raw materials, parts and components of the right standards and specifications;
- (d) Shortage of trained workmen, technicians and managers;
- (e) Inadequate credit facilities.
- (f) Difficulties in securing good factory accommodation;

(g) Shortage of electricity and other sources of power and

(h) Difficulties in marketing.

The Government of India have set up the Central Small Industries Organisation (CSIO) for providing free technical guidance to small industrialists. The Industrial Extension Service provided by the CSIO includes advice on choice of industries, purchase of machinery and equipment, designing of tools and products, and training.

While the CSIO advises the small industrialists about the right type of machinery and equipment, the National Small Industries Corporation, another agency established by the Government, arranges to supply the machinery on easy terms of hire-purchase. A major difficulty in operating the scheme is shortage of foreign exchange.

Training of personnel for and from Small Scale Industries is quite important in any programme of modernisation. The CSIO has introduced training programmes for managers, supervisors and workers.

The pace of modernisation has been hampered by difficulties in getting credit on easy terms. The Government are playing a pioneering role in providing credit to small industrialists on liberal terms.

Modernisation demands good factory accommodation. The programme of Industrial Estates in India aims at meeting this demand.

The number of places supplied with electric power in India is very small and this limits the scope of modernisation and extension of small industries.

Small Industries have various difficulties in marketing their goods. The Government's policy has been to encourage small industries to function as ancillaries to large industries. The CSIO also assists small units to get a good share in the purchases made by the Government.



E/CONF.39/D/15

26 Sept.1962

ORIGINAL : ENGLISH

**UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS**

Agenda Item: D.5.1

India

INDUSTRIAL DEVELOPMENT-PULP AND PAPER

By A. SEETHARAMIAH
and N. NARASIMHAN

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

Agenda item: D: INDUSTRIAL DEVELOPMENT

D.5.1: Pulp and Paper

(By A. Seetharamiah and N. Narasimhan)

INTRODUCTION

1. Paper is one of the basic needs of modern life. It is the most vital vehicle for propagation of education. The progress of literacy, education, social service and industries during the last few years has already led to an unprecedented increase in demand for paper in the country. This trend is likely to get intensified in the coming years. The consumption of paper and boards including newsprint, in 1961-62 was 560,000 tons against 209,000 tons in 1950-51.

EARLY HISTORY

2. The beginning of the paper industry in India dates back to 1832 when the first paper machine was established at Serampore in West Bengal. The industry which even in the early stages was conscious of the limitations and handicaps under which it was working due to the necessity of using imported pulp, took early advantage of the researches carried out at the Forest Research Institute, Dehra Dun, which established the use of bamboo as a raw material for manufacture of paper. The paper industry had to struggle hard for its existence during the early period due to stiff competition from cheap imported paper and some units had to close down. In order to protect the indigenous bamboo based paper industry, a protective duty was levied in 1925 on imported papers. This created the requisite atmosphere for the growth of paper industry in the country and the restricted availability of imported paper due to the Second World War gave a further fillip to its stabilisation and expansion. Since then the paper industry has never looked back and it has maintained a steady progress.

3. The annual production of paper and paper boards excluding newsprint in 1937 was 48,228 tons. This rose to 93,090 tons in 1947 when the protective duty was removed. The rate of increase has been well maintained and the production which was 131,915 tons in 1951 when Industrial Development in the country was taken up on a planned basis rose to 193,400 tons in 1956 and 364,118 tons in 1961. However, the per capita consumption of paper is still very low averaging about 1 kilo/year as compared to more than 200 kilos/year in U.S.A. and 50 to 100 kilos in European countries.

PRESENT POSITION OF THE INDUSTRY

4. At present there are 30 mills manufacturing paper and paper boards with a total installed capacity of 433,800 tons. Most of the existing paper mills are integrated units which manufacture pulp for conversion to paper. There is at present no unit producing only pulp. In addition, there are 27 units manufacturing millboards and strawboards with a total capacity of 82,400 tons. One unit with a capacity of 30,000 tons/year has been established for the manufacture of newsprint from Salai (*Boswellia Serratta*) a tropical hard wood in admixture with chemical pulp from bamboo. The total investment in the industry is at present of the order of Rs. 40 crores and the industry provides direct employment to 34,000 persons.

5. The existing paper mills are manufacturing almost all the common varieties of writing, printing and packing papers and boards excluding certain special types of papers such as Manila paper, condenser and cable and other electrical insulation papers, photographic base paper, carbonising tissues, glassine and vegetable parchment paper, high strength kraft paper for multi-wall bags, kraft-liner, foil paper and ivory boards which are not manufactured in the country. Steps have been taken to establish production of most of these types of papers in the next few years.

FUTURE PLAN FOR DEVELOPMENT

6. The following targets of production have been fixed for 1965-66:-

Paper & Paper Boards	-	700,000 tons/year
Newsprint	-	150,000 tons/year
Dissolving Pulp	-	100,000 tons/year

The present installed capacity of paper and paper boards is 433,800 tons/year. Additional capacity of 769,840 tons/year has been licensed. Of this 155,560 tons/year is for expansion of existing mills and 614,280 tons/year for installation of 82 new units, Table 1 summarises the present position of licensing of capacity for paper and paper boards.

7. Newsprint production in the country is at present confined to one mill with a capacity of 30,000 tons/year. The question of doubling the capacity of this mill is now under consideration. Three more licences have been issued for establishment of new newsprint mills, two with a capacity of 60,000 tons/year each and the third with a capacity of 30,000 tons/year. Two of these schemes envisage the production of newsprint from bagasse with the admixture of imported chemical pulp in the initial stages (to be replaced by indigenous pulp in a few years). The third newsprint project is to be based on soft woods available in the Himalayan region. In the case of dissolving pulp, 7 schemes based on bamboo with a total capacity of 267,600 tons per year have been licensed, out of which 4 schemes with a capacity of 141,000 tons per year have been given approval for import of plant and machinery.

8. It is estimated that by 1980-81, the per capita consumption would increase to about 7 kilos. In order to meet this demand, the perspective planning is for the expansion of capacity on the following basis:

	<u>Estimated Production in Million Tons</u>				<u>Per capita consumption</u>
	<u>Paper & Paper Boards</u>	<u>Newsprint</u>	<u>Chemical Pulp</u>	<u>Total</u>	
1970/71	1.2	0.3	0.2	1.7	3.5
1975/76	2.0	0.45	0.4	2.85	5.0
1980/81	3.0	0.60	0.6	4.20	7.0

Realization of these targets poses problems of availability of raw materials, machinery and technical manpower.

9. (a) There is a considerable divergence of views about the economic size of a paper mill. In advanced countries, the trend is to have paper mills with as large a capacity as possible producing a limited varieties of paper. Newsprint mills are invariably very much larger than paper mills.

(b) The establishment of such large units takes a long time and also requires heavy investment on plant and machinery and provision of ancillary services like water supply, power supply, rail and road transport facilities etc. Furthermore, the economic success of such large mills depends on the availability of adequate supplies of raw

materials on a sustained basis within a relatively short distance. In the earlier stages mills with capacities of 25/30 tons per day were considered to be economic. With the development of road and rail transport systems and creation of facilities for manufacture of machinery in the country, the present trend is to establish mills with capacity of 100 tons/day and more. The older mills with lower capacities are also expanding to this level.

ROLE OF SMALL UNITS OF 5/10 TONS/DAY CAPACITY

10. Although it would be desirable to set up large pulp and paper mills under special circumstances there would be scope for setting up a limited number of smaller units also. Even now in Europe and Japan a number of small paper mills are in operation. Most of these units procure pulp from outside sources and produce special types of papers which do not lend themselves for manufacture on large fast running machines. In India too a few small paper mills with capacity of 5/10 tons/day have been in operation for a number of years.

11. The question of establishing small paper units with a capacity of 5 to 10 tons per day in different parts of the country has been engaging our attention for some time past. It was evident that there would be limited scope for such units, because they would have to depend on pulp from outside sources, as conventional pulping would not be practicable in such small units in view of high cost of production and difficulties in the disposal of effluents. It was envisaged that 5 to 10 tons/day paper units could make either speciality papers or ordinary grades of printing and writing papers or wrapping papers in the vicinity of large cities where auxiliary raw materials like waste paper and rags could be collected easily and where other services such as power, water and facilities for effluent disposal would be available. It is considered that there is scope for the development of such small units to a limited extent in the country side by side with large units. A number of such small units have been licensed and it is expected that during the course of this year 12 such new small units will commence production.

POSITION OF RAW MATERIALS

12. The Indian Sub-Continent is rich in forest wealth. But the resources of soft woods (which are the conventional raw materials for the manufacture of pulp and paper in the industrially advanced countries) are restricted to the higher reaches of the lower Himalayan region. Uptil now the problems connected with the extraction and transport of timber from high mountain forests and regeneration by natural and artificial means have not been satisfactorily solved in this country. Recently steps have been taken to study the feasibility of utilization of such timbers available in Punjab and in Jammu and Kashmir for manufacture of suitable types of pulp and paper, with the assistance of experts from Canada and USSR.

13. The country had, therefore, to look for other unconventional raw materials for the manufacture of pulp and paper. Bamboo which grows widely in many parts of the country and which has a felling cycle of only 3 to 4 years has, therefore, been the obvious choice of the paper makers in this country. At present bamboo comprises about 80% of all cellulosic raw materials used in the country for the manufacture of paper and paper boards. Sabai grass (*Eliopsis Binata*) which grows in the sub-Himalayan regions is used to a limited extent. In recent years attention has been paid towards the utilization of hard woods and agricultural residues. Salai (*Boswellia Serratta*) which grows in Central India is being utilized for the manufacture of newsprint and to a small extent for other types of papers and boards. Bagasse has been used as the main raw material for manufacture of strawboard for a number of years. In 1950 M/s Rohtas Industries Ltd., Dalmianagar established a plant for the manufacture of bleached pulp from bagasse adopting the Celedecor-Pomilio Process. This pulp is being used by them in admixture with bamboo

pulp in different grades of papers and paper boards. Other units are also using bagasse to a small extent for various grades of paper in admixture with bleached pulp from bamboo/grass. A number of bagasse based units are planned to be established in the country during the Third Five Year Plan. A statement showing the Fibre Characteristics and other related properties of different cellulosic raw materials is at Annexure I.

RAW MATERIALS FOR THE FUTURE DEVELOPMENT

14.(a) The existing resources appear to be inadequate for meeting the requirements for the expansion of the pulp and paper industries beyond 1965-66. The net quantity of bamboo which could be made available for pulp and paper manufacture is about 2 million tons per year, which will only yield about 0.8 million tons of paper. All known available resources of bamboo have been earmarked for paper and pulp schemes already licensed.

(b) The average yield of bamboo in the country is only about 1 ton per acre on a four year cycle. The leased areas exploited by paper mills, however, yield on an average upto 2 tons per acre. Even this is very much below the yield of 3.5 to 4 tons/acre claimed by other countries like Japan. This is presumably due to bamboo being cultivated as a crop whereas in India extraction is from natural forests. Therefore, steps are being taken to encourage the lease of forests direct to paper mills on a long terms basis and make the paper mills responsible for maintaining and developing these forests and also to exploit the forests on scientific basis.

15. Proposals are under consideration for a country-wide survey of the cellulosic resources and selection of ecologically favourable areas for plantation of suitable fast growing species and to launch on an intensive reafforestation programme. A start has been made on the plantation of Eucalyptus and Wattle in the Nilgiris in the Madras State and in Kerala State. Proposals are also under consideration for plantation of suitable species of eucalyptus and pine in other suitable parts of the country at the rate of 100,000 acres annually over the next 15 years. When this programme materialises about 4.5 million tons of pulpable timber could be expected to be made available to the paper industry. As bamboo normally grows as an under cover, the feasibility of growing bamboo alongwith other species of timber is also receiving consideration. These steps, however, even under the most favourable considerations are not likely to yield results before 1980 and in the meanwhile the further expansion of the industry has to be based on bagasse and other agricultural fibres.

16.(a) Based on an annual production of 3.2 million tons of sugar, the annual availability of bagasse on a bone dry basis is estimated at 3.75 million tons. This quantity would be sufficient to produce 1.5 million tons of paper annually if it could be made available for paper manufacture. Bagasse is, however, at present the main source of fuel available on the spot in the sugar mills. Some time back the Government suggested to all the sugar mills in the country to release bagasse for manufacture of paper by modifying their existing boilers for firing alternative fuel (coal/oil). The question of exempting levy of excise duty on furnace oil when used for replacement of bagasse is also under consideration in order to make the use of furnace oil economically attractive to the sugar mills.

(b) The two methods by which bagasse could be released for pulping are (1) improved thermal efficiency in the sugar mills; and (2) use of alternate fuel. The operation conditions in sugar mills vary from one area to another and release of bagasse by improvement of thermal efficiency may present serious difficulties and even then the quantity released might not be more than 40% of the total bagasse production. The use of alternate fuel under suitable conditions will release all the bagasse produced. In the context of the present difficult fuel supply position in the country, the former method has been recommended to the industry for immediate consideration. There are, other problems as the sugar mill operations are seasonal while paper mills work all round the year.

17. During the past decade there has been significant progress towards greater utilization of other agricultural fibres such as rice-straw, cereal straws, grasses and reeds. A considerable amount of technical information and experience has become available, and pulping techniques have been developed for converting most of these fibrous raw materials into pulp and by suitable admixture of these pulps it is now possible to manufacture a wide range of papers. The possibilities of harnessing the resources of such raw materials in this country in the coming years is receiving attention. A step has already been taken in this direction with the recent success in the utilization of jute sticks for the manufacture of paper.

18. The other raw material resources which are not harnessed adequately for paper manufacture are waste paper and rags. The utilization of waste paper in India is only 12% against 30% in other countries. It has been recognized that it is in the interest of the paper mills to organize collection of waste paper and rags on a systematic basis.

RESEARCH AND DEVELOPMENT

19. Because of the difficulties in harnessing conifers (such as fir, spruce and pine), that have been explained in the preceding paragraphs, the Indian Pulp and Paper Industry had to develop on unconventional indigenous raw materials which had not been utilised elsewhere. Research in the field of utilization of bamboo and sabai grass for the manufacture of pulp was initiated in the Forest Research Institute Dehra Dun in the early twenties. As a result of this the two-stage Sulphate Process for the pulping of bamboo was developed. This pulping process with slight adaptations is now widely adopted by all the paper mills in the country except one which adopts the Mg base acid sulphite process. All the Sulphate mills recover chemicals for reuse and the sulphite waste liquor is at present concentrated and used in road building.

20. In 1948-49, studies were taken up for the utilization of some of the tropical hard woods available in the country for manufacture of newsprint. Experiments carried out in the Forest Research Institute, Dehra Dun indicated that newsprint could be manufactured utilising ground wood pulp from Salai (*Boswellia Serratta*), and bleached kraft pulp from bamboo. This was further confirmed by the Research work undertaken in the USA and the first 100 tons/day mill for the manufacture of newsprint utilizing 65% of Salai Ground Wood Pulp and 35% bleached bamboo kraft pulp was established in the country in 1955. Considerable difficulties were experienced by this mill in the initial stages because of the new raw materials used and steps have been taken to resolve the difficulties. Recently the Dehra Dun Institute has taken up work regarding the utilization of "Palas" (*BUTEA MONDSPERINA*) which is another species of hard wood growing fairly abundantly in Central India for manufacture of newsprint. Results so far obtained are encouraging and work on pilot plant and semi-commercial production are to be undertaken shortly. Further expansion of the existing newsprint mill is to be based on the results of these studies. The Forest Research Institute in active collaboration with the State Forest Authorities are also considering the problems connected with the regeneration of Salai wood and "Palas".

21. The requirement of rayon grade pulp, which is now met wholly by imports, is of the order of 75,000 tons per year and this is likely to grow to 100,000 tons by end of 1965-66. Over the last few years efforts have, therefore, been made to take up production of rayon grade pulp within the country utilising indigenous raw materials. Here again the difficulties of getting soft woods made it imperative for the industry to look for other unconventional raw materials. The possibility of using bamboo and bagasse for rayon grade pulp manufacture has been studied. Initially considerable research work was done on the initiative of the Government of India in West Germany and Japan. A few years back two of the leading Indian manufacturers of rayon and staple fibre established suitable pilot plants for studying rayon grade pulp manufacture from indigenous raw materials. The work done in these pilot plants so far with the active assistance of overseas collaborators (especially the Japan Consulting Institute, Tokyo, The International Paper Co., U.S.A.,

and Rayonier (Inc.) U.S.A.) has proved the technical and economic feasibility of manufacture of dissolving grade pulp from bamboo. Encouraged by these results licences have been granted for the manufacture of rayon grade pulp as indicated in para 7. The first unit for rayon grade pulp with a capacity of 54,000 tons per year is expected to commence production during the later part of this year. The pulping process to be adopted in this mill has been developed in their own pilot plant. The work regarding manufacture of rayon grade pulp from bagasse is still continuing. Results obtained so far indicate that bagasse might be an equally, if not more suitable raw material, for rayon pulp.

22. Studies have also recently been undertaken regarding use of bagasse for newsprint manufacture by some of the leading newsprint mills in U.S.A., West Germany and Japan, on behalf of the Indian firms who have been licensed for the manufacture of newsprint. The work so far carried out has indicated that manufacture of newsprint with a high percentage of bagasse pulp furnish is technically feasible. The economics of production and establishment of optimum conditions for pulping and newsprint production on high speed machines are still being studied.

23. Besides some of these major developments, work is also being constantly carried on by several paper mills to increase the yield of pulp, recovery of chemicals and fuel efficiency.

24. The implementation of the development plans by the industry requires a large number of trained technical personnel. Most of the large paper mills have their own apprentice training schemes. The Forest Research Institute offers courses in Pulp and Paper Technology and also training in pilot plant and semi-commercial production. These facilities are being expanded to meet the increasing demand for trained personnel.

MANUFACTURE OF PLANT AND MACHINERY

25. Pulp and Paper is a capital intensive industry. An integrated 100 tons/day pulp and paper plant requires an investment of about Rs. 7/8 crores of which the foreign exchange requirement is approximately Rs. 5 crores. The annual expenditure on spare parts and consumable stores for maintenance of production of the industry alone amounts to over Rs. 4 crores. Import licences to the extent of Rs. 44 crores have already been granted for plant and machinery required for achieving the targets envisaged for 1965-66. The country cannot, however, afford such a continuous heavy drain of foreign exchange. Further growth of the industry would have to depend on indigenous machinery. It would facilitate the manufacture of plant and machinery in the country and the production of consumable stores and spares, if the sizes of the plants were standardized. After careful examination it was decided that plants to be fabricated in the country should have capacities of 10 tons/day and below, 50/60 tons/day, and 100 tons/day and above. As the manufacture of paper mill machinery is highly specialised and even in foreign countries there are only a few reputed manufacturers of this machinery, such fabrication is being undertaken in collaboration with some of the leading pulp and paper mill machinery manufacturers in U.S.A., U.K., Sweden, West Germany, France and Japan.

CONCLUSION

26. The paper industry in India has made significant progress during the last decade. There has been a four-fold increase in production since 1947 when the country became independent. The fulfilment of the targets of production for 1980-81 would enable India to become one of the leading paper manufacturing countries of the world. The achievement of these targets no doubt present very serious problems particularly about raw materials, machinery and equipment, technical manpower and capital resources. Concerted efforts are being made to tackle all these problems. It is expected that by 1980-81 the country besides being self-sufficient with regard to paper and paper products, would also be in a position to export sizeable quantities of these products at least to neighbouring countries.

TABLE - 1

(1) STATE	(2) Mills in operation		(3) Additional capacity licensed			(4) Total capacity licensed
	No. of units.	Existing capacity (tons/year)	Expansion of exist- ing units (tons/year)	New Units		(2 + 3)
				No.	Capacity (tons/year)	
ASSAM	-	-	-	3	36,120	36,120
BENGAL	5	97,050	13,800	5	11,100	121,950
UTTAR PRADESH	2	26,400	-	10	126,180	152,580
BIHAR	1	60,000	37,500	5	27,300	124,800
ORISSA	2	72,000	6,000	2	21,000	99,000
PUNJAB	3	36,600	1,560	4	37,200	75,360
MADHYA PRADESH	1	5,400	-	8	111,900	117,300
GUJARAT	2	9,000	3,600	5	16,060	28,660
MAHARASHTRA	7	29,910	30,900	22	133,860	194,670
ANDHRA	2	39,000	26,400	1	1,500	66,900
MYSORE	4	49,800	32,800	5	38,600	121,300
KERALA	1	8,640	3,000	2	6,000	17,640
MADRAS	-	-	-	8	42,560	42,560
RAJASTHAN	-	-	-	1	1,800	1,800
HIMACHAL PRADESH	-	-	-	1	3,000	3,000
	30	433,800	155,560	82	614,280	1,203,640

Annexure - I

COMPARATIVE CHEMICAL COMPOSITION & PHYSICAL PROPERTIES OF WOOD AND OF COMMON NON-WOODY FIBRES

FIBRE	ASH	LIGNIN	PENTOSANS	CROSS & BEYAN CELLULOSE	ALPHA CELLULOSE	AVERAGE FIBRE (MICRONS)	
						LENGTH	DIA
RICE STRAW	14-20	12-14	23-25	46-49	28-36	1450	8.5
STRAWS (Others)	6-8	17-19	27-32	50-54	33-38	1100-1500	9-13
REEDS	3-6	18-22	28-32	52-58	33-43	1000-1800	8-20
BAGASSE	2	19-21	30-32	59-62	40-43	1700	20
WOODY FIBRES FROM STALKS WITH BAST FIBRES	2-3	23-37	15-22	40-48	31-33	200-300	10-11
BAST FIBRES FROM ABOVE (e.g. Linen)	1-2	1-6	2-6	70-80	60	20,000-25,000	16-22
LEAF FIBRES (Hemp)	0.6-1.2	7-10	17-24	70-80	53-64	6000-9000	16-18
BAMBOO	1-2	24-29	16-18	60-63	50	2700	14
CONIFERS	Below 1	26-34	7-14	53-62	40-45	2700-3600	32-43
DECIDUOUS WOODS	"	23-30	19-26	54-61	38-49	1000-1600	38-50

SOURCE: "Cellulose Pulp" by Julius Grant.



UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

E/CONF.39/D/15

SUMMARY

26 Sept.1962

ORIGINAL : ENGLISH

SUMMARY

Agenda Item: D.5.1

India

**INDUSTRIAL DEVELOPMENT :
PULP AND PAPER**

By A. SEETHARAMIAH
and N. NARASIMHAN

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

Agenda item: D: INDUSTRIAL DEVELOPMENT

D.5.1: Pulp and Paper

(By A. Seetharamiah and N. Narasimhan)

Authors' Summary

EARLY HISTORY

1. Paper industry, which was established in India nearly 100 years ago, has been steadily growing. The industry took early advantage of the researches carried out in India, which established the use of bamboo as a raw material for paper manufacture. The production which was about 93,000 tons in 1947 increased to 193,000 tons in 1956 and to 364,118 tons in 1961. The per capita consumption is one kilo/year.

PRESENT POSITION OF THE INDUSTRY

2. At present there are 30 paper and paper board mills, 27 strawboard mills and one newsprint mill, with a total capacity of 546,200 tons/year. Most of the existing paper mills are integrated units which manufacture pulp for conversion to paper. There is no unit producing only pulp. The industry has an investment of about Rs. 40 crores and provides direct employment to 34,000 persons. All the common varieties of papers and boards are now being manufactured. Steps have been taken to produce specialty papers, the demand for which is small.

FUTURE PLANS FOR DEVELOPMENT

3. The following targets of production are to be achieved by 1965/66:

Paper and paper boards	..	..	700,000 tons/year
Newsprint	..	..	150,000 tons/year
Dissolving Pulp	..	..	100,000 tons/year

The present capacity for paper and paper boards is 433,800 tons. Additional capacity of 769,840 tons/year has been licensed. Three new newsprint mills with a capacity of 150,000 tons/year (two of which are bagasse based) and seven schemes for dissolving pulp with a capacity of 276,600 tons have been licensed. It is expected that the per capita consumption of paper would increase to about 7 kg. by 1980-81; the perspective planning is for expansion of capacity to 3 million tons of paper and paper boards and 0.6 million tons each of newsprint and chemical pulp.

4. The present trend is to establish large economic units with capacity of 100 tons/day and more and also to expand the existing smaller mills to this level.

ROLE OF SMALL UNITS OF 5-10 TONS/DAY CAPACITY

5. It is considered that there is scope for a limited number of smaller units near large cities where auxiliary raw materials like waste paper and rags could be collected easily and where other services such as power, water and facilities for effluent disposal would be readily available.

POSITION OF RAW MATERIALS

6. Bamboo at present constitutes about 80% of all cellulosic raw materials used. Sabai grass (*ELIOPSIS BINATA*), Salai (*BOSWELLIA SERRATTA*) and bagasse are also being used to a limited extent. Recently, attention has been paid for large utilization of hard woods and agricultural residues.

RAW MATERIALS FOR THE FUTURE DEVELOPMENT

7. Steps are being taken to ensure adequate raw materials for future development by (a) increasing the yield of bamboo from the existing forests (b) undertaking plantation of suitable fast-growing species of timbers and bamboo as under-cover (c) encouraging sugar mills to release bagasse, for paper manufacture by effecting economies in the use of fuel and by using alternative fuel; (d) harnessing agricultural residues (e) encouraging Paper Mills to intensify collection of waste paper and rags and (f) harnessing the soft wood resources of the lower Himalayan region.

RESEARCH AND DEVELOPMENT

8. The Indian Paper Industry had to be developed on unconventional indigenous raw materials. The two-stage sulphate process for pulping of bamboo developed in the Forest Research Institute is now being widely adopted with slight modifications by all the paper mills except one which adopts the Mg base acid sulphite process. All the sulphate mills recover chemicals for re-use.

9. Based on work done in the Dehra Dun Institute, and U.S.A., newsprint manufacture utilizing 65% ground wood pulp from salai (*BOSWELLIA SERRATTA*) and 35% bleached bamboo kraft pulp has been undertaken in a 100 tons day mill. For expansion of this mill the use of "Palas" (*BUTEA MONDSPERINA*) is contemplated. Pilot plant and semi-commercial production are to be undertaken shortly. The problems of regeneration of these species of hard woods are under investigation.

10. Studies to utilize bamboo and bagasse for dissolving pulp manufacture have been undertaken. Pilot plant work carried out in India, Japan and U.S.A. has established the technical and economic feasibility of using bamboo for dissolving pulp. The first unit with a capacity of 54,000 tons/year is to start production during 1962-63. The work on bagasse is continuing.

11. Studies undertaken in India, U.S.A., West Germany and Japan has established the technical feasibility of newsprint manufacture with a high bagasse-pulp furnish. The economics of production, establishment of optimum conditions for pulping and production on high-speed machines are under study. Constant attention is being paid to increase the yield of pulp, recovery of chemicals and fuel efficiency.

MANUFACTURE OF PLANT AND MACHINERY

12. The country is now dependent on imported plant and machinery. Schemes have been approved for the manufacture of pulp and paper machinery in the country in collaboration with some of the reputed overseas manufacturers.

**E/CONF.39/
D/16**



E/CONF.39/D/16
29 Sept. 1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.14

United Kingdom

THE INDUSTRIALISATION OF BUILDING TECHNIQUES

By Roger WALTERS, A.R.I.B.A., A.M.I., Struct.E.,
Chief Architect (Development),
War Office,
London

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

THE INDUSTRIALISATION OF BUILDING TECHNIQUES

Roger Walters, A.R.I.B.A., A.M.I.Struct.E.,
Chief Architect (Development), War Office, London.

1. The first part of this paper briefly describes the present position in the United Kingdom. The second part suggests some principles, based on the U.K. experience, which may be applicable in the less developed areas.

PART I. THE PRESENT POSITION IN THE UNITED KINGDOM

The need for industrialisation

2. The expenditure on construction work of all kinds in the U.K. was £2138 millions in 1961. Deducting civil engineering work, the expenditure on building was £1620 millions. At a conservative estimate, it is expected that the demand for building will increase by an average of about 3% per year. This means that the output of the building industry must be approximately doubled in 25 years. But, during this time, the labour force available is not expected to increase by more than 5%.

3. There has already been a substantial increase in the use of mechanical plant on the construction of buildings designed in the conventional way, i.e. where brickwork, in-situ reinforced concrete or steelwork encased in concrete are the principal structural materials. Tower cranes, ready mixed concrete, mechanical hoists and power tools are extensively used. But it is now being recognised that the required improvement in the output of the industry can only be achieved by radically changing the way in which buildings are designed.

System of prefabrication

4. A great many systems of prefabricated construction have been invented in the U.K. since the war. The most successful are the 'light and dry' systems designed primarily for school building. Some of these have been designed by architects in central or local government authorities; others by commercial firms. They consist essentially of factory made components which can be assembled together to make buildings of any required plan form. The objective is to be able to design buildings of the greatest possible variety with the least possible number of types and sizes of components.

5. Other kinds of system include those using large, heavy components in pre-cast concrete which have been developed mainly for multi-storey flats and office buildings. Systems are now being introduced from other European countries in which concrete is cast on site in highly standardised formwork.

The CLASP system

6. The most widely used of the 'light and dry' methods of construction is the CLASP system. The first CLASP school was erected in 1957; the first year's programme in 1957-58 amounted to £0.8 millions; the value of the 1962-63 programme is about £10 millions.

7. The CLASP system consists 50% of factory made components. These include the light steel frame, heating system components, pre-cast concrete cladding, window frames, aluminium sliding windows and ventilating louvres, rubber floor finishes, eaves units, roof lights, light gauge steel vitreous enamelled panels, internal doors, pre-fabricated partitions and sanitary fittings.

8. In the CLASP frame, beams consist of welded lattices of hot rolled and cold rolled angle sections with a flat lower chord. Stanchions are of box section made from cold rolled light gauge steel strip, or hot rolled square tube, according to the load.

9. CLASP buildings are designed on a planning grid of 3'4"; external walls may change direction at 6'8" or 10'0" intervals; buildings may be up to 4 storeys high.

10. A number of public authorities have formed a consortium to use the CLASP system whereby they pool their requirements for the factory-made components and orders for these are placed centrally. CLASP buildings are now cheaper than buildings of conventional construction of equivalent quality. Erection times are considerably faster.

11. The CLASP system is now being used in Germany and Italy. A modified version of it, with a 1'8" planning grid, is being developed for 2 to 3 storey low cost housing.

Other systems being developed

12. At the present time, several other systems are being developed, based on the CLASP experience. One of these is the NENK method of building which is being designed in the War Office. Here the system must be able to cater for a wide variety of different types of permanent building; higher performances in loading, sound insulation and fire resistance are also needed. The NENK method has a light steel structural frame in which the floors and roofs are of space frame construction. This allows more freedom in planning: internal partitions may be placed on any 4" interval; external walls may change direction at 4'0" intervals. At the present stage of development, buildings may be up to 4 storeys high.

The long term aim

13. The 'light and dry' systems of pre-fabricated construction, now current in the U.K., may be regarded as an intermediate stage in the progress towards fully industrialised building techniques. At present the components for each system have to be specially ordered according to the size of the programme. The long term aim is to have factory-made components available on the free market; components which are well-designed functionally and aesthetically, which are dimensionally co-ordinated, and which are interchangeable with one another. Up to now, components can only be used within the system for which they have been designed. A great deal more work on dry-jointing techniques needs to be done before they can be made freely interchangeable.

Statements of future demand

14. In the U.K. about 50% of building is in the public sector; in other words, commissioned by central Government departments, local authorities and the nationalised industries.

15. Traditionally, programmes of public building have been determined from one year to the next. But this has left too much uncertainty; designers have not been able to look far enough ahead; the incentive to develop radically new techniques has been lacking.

16. It is where large client authorities have been able to state their future demands for longer periods ahead, e.g. for schools, that rapid technical development has taken place.

Development groups

17. Another very important factor has been the formation of development groups in central Government departments. Development groups are now at work in the Ministries concerned with schools, housing, hospitals and buildings for the Army.

18. Development groups usually consist of architects, administrators and quantity surveyors. Their functions are:-

- (a) To study human activities in great detail, in order to establish the real needs of the users of buildings;
- (b) To evolve new planning solutions and to design furniture and equipment;
- (c) To invent techniques appropriate to the efficient erection of a large number of buildings carried out in a planned sequence;
- (d) To study cost and cost control;
- (e) To study building management, i.e. the way in which all members of the building team work together.

19. Development groups carry out actual projects onto which they focus their studies and by which they test their new ideas in practice. Such groups have originated many of the industrialised building techniques now in use.

Modular coordination

20. In the U.K., national agreement on modular coordination has not yet been reached, but most of the designers of systems of industrialised building are using nominal dimensions which are multiples of 4".

Cost planning

21. Quantity surveyors in the U.K. have evolved a technique for fixing the target cost for a building, in cooperation with the architect, at the early stages of planning. The target cost is broken down into costs for each element (frame, roof, floor, internal partitions etc), measured in shillings per square foot of the total floor area of the building. Throughout the design stage, the cost of each element is checked. The total cost of the building is thus kept under control at all times.

22. Cost planning has been of very great value to the designers of systems of industrialised building.

Cooperation with component manufacturers

23. Some of the best technical development in the U.K. has occurred when there has been active cooperation between architects and the manufacturers of components such as structural frames, cladding panels, heating systems and sanitary fittings.

Manufacturers have usually been glad to cooperate on development work where the intention is to standardise components for quantity production in relation to a firm building programme.

PART II. THE APPLICATION OF U.K. EXPERIENCE IN LESS DEVELOPED AREAS

Principles common to all countries

24. At first sight, the recent experience in the U.K. may seem to have little application in the less developed areas. The work which is now proceeding in the U.K. is based on a comparatively high level of professional and technical skills; on a relatively sophisticated manufacturing industry; on a fairly well trained body of operatives; and is taking place in a small country without serious problems of transport.

25. Nevertheless, there are certain principles which can be identified from the U.K. experience which are likely to be common to all those countries in which a rapid increase in the output of building is needed. Some of these principles are described in the following paragraphs.

Continuity of demand

26. The first principle is to establish continuity of demand. This implies Government action to survey the overall building requirements of the country for at least five years ahead and preferably more. Within this broad survey, the requirements can be sub-divided by types of building and in this way the major demands can be established. One of these will almost certainly be for housing and this demand can again be sub-divided into urban and rural housing, each of which may need a different approach. Other major demands may be for schools, industrial buildings, medical buildings and so on.

27. Having related these demands for building to the capital and resources which are likely to be available, programmes can be drawn up. It may be wise not to expect to make progress in industrialisation over the whole range of any one programme. It may be better to select part of each programme for special attention, remembering that the objective is to give those engaged on technical development the firm assurance that their part of the programme will in fact be carried out. Industrialisation will proceed rapidly only where there is real continuity of demand.

Formation of development groups

28. The second principle is to organise professional and administrative skills in an effective way. Given firm programmes for each type of building, it should be possible to set up development groups and to charge them with the task of working out industrialised building techniques appropriate to each programme. Each development group should contain the best available skills in design, cost control and administration. The rôle of such a group is first to study the functional requirements of the buildings in the programme and then to produce appropriate technical solutions. It is the responsibility of the group to produce results which are viable in the political, economic and technical contexts of its country. It is the responsibility of the parent organisation to which the group belongs to apply the group's findings as widely as possible. The parent organisation should preferably be a Government department, and the group should be so placed that its professional leader is directly responsible to the top

professional man in the department. The development group should build experimental projects but its work should be kept separate from that of the production teams responsible for carrying out the programme as a whole.

Assessment of resources

29. The first task of each development group is to assess the resources which can be brought to bear on its programme, for instance:-

- (a) The capacity of the professional staff available to design individual buildings within the programme;
- (u) The availability of raw and processed materials;
- (c) The existing and potential capacities of the manufacture of building components.
- (d) The capabilities of building contracting organisations, the availability of plant and the levels of skill of site operatives;
- (e) The problems of geographical location and transport.

Choice of method

30. In the light of all the relevant factors, the group should be able to determine in principle which method of building to adopt for the programme. Three basic alternative methods may be distinguished, according to where the bulk of the machinery or plant is applied.

- (a) 'Light and dry'. In this method the majority of the components are made by machines in factories and erection on site is reduced as far as possible to a semi-skilled assembly process. A framed system of construction is preferred, using steel, timber or aluminium as the principal structural material. Other components are also kept as light as possible, using such materials as lightweight concrete, timber, aluminium sheeting, chip-board, fibre-board, plaster-board, plastics etc. Sizes of components are controlled by transport requirements and by the need for simple handling on site. This method allows great flexibility in the design of individual buildings and buildings may be placed on any site which transport can reach.
- (b) 'Heavy and dry'. Here the principal components are also pre-fabricated but of a size and weight which prohibits long-distance transport. A load-bearing panel system of construction is preferred, using reinforced concrete cast in large sizes with a high quality of finish. A central pre-fabricating plant is required and fairly heavy lifting devices must be available on sites. This method still allows a certain amount of flexibility in the design of individual buildings, but buildings can only be placed within a limited distance from the main plant. The use of the central prefabricating plant, after the main demand in its area has been met, needs to be considered in advance.
- (c) 'Wet and heavy'. Here the building is not prefabricated, but the site operations are mechanised. A load-bearing system of in-situ concrete walls is preferred, using highly standardised formwork which can be quickly assembled and dismantled. Walls may be cast on edge or may be lifted in place after casting horizontally. This method requires a substantial amount of

equipment on every building site and a skilled labour force. It is most effective when building design has been completely standardised.

31. It is, of course possible to rationalise traditional methods of building; to improve processes such as brick-making, block-making, timber conversion, joinery production and so on; and to improve the level of organisation and skill of site operatives. But such improvements inevitably take a long time to accomplish. Any country which is faced with a large building demand may find it more effective to concentrate on industrialised techniques in the first instance; to choose those which are appropriate to its needs; and to arrange the training of its management, staff and operatives accordingly.

Integration of organisations with the building industry

32. The trend for the future is almost certainly towards the pooling of skills within the building process and towards the integration of organisations within the building industry. It can be a drawback to have a well established building industry which is fragmented according to traditional trades and crafts; in which the professional and contracting interests are firmly entrenched in numerous separate institutions. In this respect, the balance of advantage may well lie with the less developed countries of the world.

Bibliographical references

33. The following is a short list of references:-

- (a) Economic Commission for Europe, Government Policies and the Cost of Building, United Nations, Geneva (1959).
- (b) Walters, Roger, The Structure of the Building Industry, R.I.B.A Journal, February, 117-120 (1960).
- (c) Walters, Roger, The Purpose and Organisation of Development Groups, R.I.B.A. Journal, May, 273-279 (1960).
- (d) Ministry of Education, The Story of CLASP, Building Bulletin 19, London (1961).
- (e) Organisation for European Economic Cooperation, Modular Coordination, Second Report of EPA Project 174, (1961).
- (f) Lea, Dr. F. M., The Building Industry in an Expanding Economy The Builder, 8th June, 1195-1201 (1962)



UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

E/CONF.39/D/16
SUMMARY
29 Sept. 1962
ORIGINAL : ENGLISH

SUMMARY

Agenda Item : D.14

United Kingdom

**THE INDUSTRIALISATION
OF BUILDING TECHNIQUES**

By Roger WALTERS,
A. R. I. B. A., A. M. I. Struct. E.,
Chief Architect (Development),
War Office,
London

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

SUMMARY

THE INDUSTRIALISATION OF BUILDING TECHNIQUES

Roger Walters, A.R.I.B.A., A.M.I.Struct.E.,
Chief Architect (Development), War Office, London.

1. The demand for building in the United Kingdom is expected to double during the next 25 years while the labour force increases by only 5%.
2. Mechanisation of conventional building methods is not enough; the required improvement in output can only be achieved by radical changes in design.
3. The most successful systems of prefabricated construction in the U.K. are of the 'light and dry' type which have been designed primarily for school building.
4. The most widely used of these is the CLASP system; size of the CLASP programme is now £10 millions a year. The system consists of 50% of factory-made components: light steel frame, heating system components, pre-cast concrete cladding, window frames, rubber floor finishes, eaves units, roof lights, light gauge steel vitreous enamelled panels, internal doors, prefabricated partitions, sanitary fittings. Buildings are planned on a 3'-4" grid and may be up to 4 storeys high.
5. Several public authorities combine to use the CLASP system; orders are placed centrally. CLASP buildings are cheaper than buildings of conventional construction of equivalent quality; erection times are faster. The CLASP system is also being used in Germany and Italy.
6. Among other systems now being developed, the NEWK method of building is being designed in the War Office. This has to cater for many different types of building; higher performances in loading, sound insulation and fire resistance are needed. The NEWK method has floors and roofs of light steel space-frame construction and will allow much greater flexibility in planning.
7. The 'light and dry' systems may be regarded as an intermediate stage in the progress towards fully industrialised building techniques. The long term aim is to have factory-made components which are available on the free market and which are interchangeable with one another. Much more work is needed on dry-jointing techniques.
8. In the U.K. about 50% of building is in the public sector. Programmes of building determined from year to year leave too much uncertainty. Where large client authorities have been able to state their future demands for larger periods ahead, rapid technical development has taken place.
9. Development groups have been formed in the Ministries concerned with schools, housing, hospitals and buildings for the Army. Such groups have originated many of the industrialised building techniques now in use.
10. Other valuable aids are (a) modular co-ordination, (b) cost planning, which allows the cost of each element of a building to be controlled at all stages of design, (c) close cooperation between designers and component manufacturers.

11. From the U.K. experience, certain principles may be identified for application in the less-developed areas.

12. Government action is necessary to establish forward demands for majority types of building for at least 5 years ahead, preferably more. Firm programmes can then be formulated to which technical development can be related.

13. Development groups can be set up in relation to each programme; each group should contain the best available skills in design, cost control and administration. The parent organisation should preferably be a Government department; the development group should be placed high in the organisation. The group should build experimental projects but its work should be kept separate from that of production teams.

14. The development group should assess the available resources, for instance:-

- (a) The capacity of the professional staff available to design individual buildings within the programme;
- (b) The existing and potential capacities of the manufacturers of building components;
- (c) The capabilities of building contracting organisations, the availability of plant and the level of skill of site operatives;
- (d) The problems of geographical location and transport.

15. In the light of all the relevant factors, the group should be able to determine which method of building to adopt. There are three principal categories:-

- (a) 'Light and dry'. Majority of components made in factories; erection a semi-skilled process; a framed system preferred. Allows great flexibility in design; buildings may be placed anywhere that transport can reach.
- (b) 'Heavy and dry'. Large pre-cast concrete components made at a central plant; load bearing panel system preferred. Less flexible in planning; requires heavy lifting devices on site; buildings can only be placed within a limited distance from the main plant.
- (c) 'Wet and heavy'. Mechanised site operations using in-situ concrete in highly standardised formwork. Requires substantial equipment on every site and a skilled labour force. Most effective when building design is completely standardised.

16. Traditional building processes may be rationalised and levels of skill improved, but this takes a long time to accomplish. It may be more effective to adopt industrialised building techniques in the first instance.

17. The trend for the future is towards the pooling of skills and the integration of organisations within building industries. It can be a drawback to have a well-established building industry which is fragmented according to traditional trades and crafts; in which the professional and contracting interests are firmly entrenched in numerous separate institutions. In this respect, the balance of advantage may lie with the less developed countries of the world.



E/CONF.39/D/17

29 Sept. 1962

ORIGINAL : FRANCAIS

**CONFÉRENCE DES NATIONS UNIES
SUR L'APPLICATION DE LA SCIENCE ET DE LA TECHNIQUE
DANS L'INTÉRÊT DES RÉGIONS PEU DÉVELOPPÉES**

Point de l'ordre du jour : D.14

France

**POSSIBILITES DE LA PREFABRICATION
DANS LES PAYS OU LE COUT DE LA MAIN-D'OEUVRE
EST PEU ELEVE**

Par G. BLACHERE,
Directeur du C. S. T. B.

Les mémoires rédigés à l'intention de la Conférence des Nations Unies sur l'application de la science et de la technique dans l'intérêt des régions peu développées sont des documents de travail. Ils sont publiés tels qu'ils ont été présentés et les assertions et opinions qu'ils contiennent sont celles de leurs auteurs.

NOTES

1. Les mémoires choisis pour être présentés en séance générale pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.
2. Les mémoires choisis pour être présentés en séance spéciale pourront être obtenus à la Conférence dans l'une seulement de ces langues officielles.
3. Les résumés qui ont été rédigés pour tous les mémoires par les auteurs de ceux-ci pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.
4. Préalablement à la Conférence, les mémoires et les résumés ne feront pas l'objet d'une distribution générale mais d'un tirage restreint destiné aux délégations des gouvernements et autres participants officiels. La publication et la distribution générale des actes de la Conférence s'effectueront conformément aux règles et pratiques agréées par le Comité des publications des Nations Unies.

POSSIBILITES DE LA PREFABRICATION DANS LES PAYS
OU LE COUT DE LA MAIN D'ŒUVRE EST PEU ELEVE

La préfabrication en Europe occidentale a vu le jour en France, c'est-à-dire dans un pays de plein emploi, où l'on manque de main d'oeuvre depuis 15 ans, et l'une des causes réelles du développement de la préfabrication dans notre pays est bien ce manque de main d'oeuvre. De là à conclure qu'à l'inverse, dans les pays de main d'oeuvre abondante, il n'y a pas de place pour la préfabrication il n'y a qu'un pas, souvent franchi: On pense que ce serait augmenter le chômage que de faire appel à des procédés mécanisés de construction.

Cette vue des choses n'est pas exacte. Il est vrai que dans les zones rurales, la méthode Castor (self-help) est la méthode qui doit être employée en premier pour améliorer l'habitat des familles à revenu très faible. Mais nous allons voir, dans la méthode self-help l'embryon de l'idée qui rend utile l'emploi de la préfabrication, même dans les pays à main d'oeuvre excédentaire. Nous savons tous qu'il n'est pas question de faire construire à des Castors de la maçonnerie de pierre. Nous leur ferons construire de la maçonnerie de parpaings de béton ou éventuellement de blocs de terre stabilisée. Ces parpaings et ces blocs sont fabriqués par des machines qui donnent des produits d'une forme correcte et qui peuvent être mis en oeuvre par une main d'oeuvre non qualifiée.

Ainsi la machine, même dans le self help, permet l'emploi au bâtiment d'une main d'oeuvre non qualifiée qui sans cela ne pourrait pas être employée. C'est la même raison qui joue avec beaucoup plus de force dans le cas des constructions dans des agglomérations et surtout la construction d'immeubles collectifs dans les métropoles. En effet, dans les pays où le coût de la main d'oeuvre est peu élevé, il n'est pas exact de parler de chômage, car ce ne sont pas des ouvriers qualifiés qui sont sans travail, il faut parler de personnes inoccupées, ce sont des gens venus de la campagne à la ville, qui sont agriculteurs mais pas ouvriers, ou ce sont des gens nés dans les bidons-villes, qui n'ont pas de métier non plus.

Pour utiliser une telle main d'oeuvre au bâtiment, il y a trois façons :

La première, c'est de leur apprendre un métier du bâtiment. C'est long. L'expérience prouve qu'on a du mal à en former de grandes quantités, même lentement. Enfin, le problème se pose, dans les pays qui n'ont souvent pas de véritable tradition du bâtiment, de savoir quelle technique traditionnelle on va leur apprendre. Leur apprendra-t-on le limousinage ou la charpente en bois à la façon du XVIII^e siècle ? Autrement dit, ne forme-t-on pas des gens à une des techniques exotiques et dépassées ?

La deuxième façon, c'est de les affecter comme manoeuvres au service de l'ouvrier qualifié. Nous aurons en moyenne un manoeuvre pour un ouvrier qualifié et demi ou pour deux. Nous sommes donc ramenés au problème précédent et cet emploi est un emploi limité.

Le troisième moyen, c'est en quelque sorte la qualification de l'ouvrier remplacée par la qualification de la machine servie par des ouvriers spécialisés, mais dans des techniques modernes : conducteurs d'engins, mécaniciens, etc...

et donnant du travail à des ouvriers qui sont d'ailleurs mieux que des manoeuvres, des ouvriers demi-spécialisés. Cette demi-spécialisation, qui consiste en une connaissance des opérations à faire dans le processus d'une préfabrication déterminée, qui met en jeu des qualités de jugement et d'intelligence autant et plus que d'habileté manuelle, s'acquiert rapidement.

Dans les procédés de préfabrication les plus évolués, c'est-à-dire dont tous les éléments sont préfabriqués en usine, la proportion d'ouvriers spécialisés par rapport à celle des manoeuvres, mis à part les finitions, est de moins d'un ouvrier spécialisé pour deux manoeuvres. On voit donc l'avantage des procédés de préfabrication pour fournir du travail : l'emploi dans le bâtiment cesse d'être limité par le nombre des ouvriers spécialisés ; il est limité mais moins sévèrement par le nombre des mécaniciens, électriciens, conducteurs d'engins, etc...

C'est parce que la préfabrication libère de l'obligation d'emploi de main d'oeuvre spécialisée que, ^{dans} des pays aussi traditionnellement bâtisseurs que l'Italie, par exemple, et où la main d'oeuvre inoccupée est hélas, abondante dans certaines régions, la préfabrication fait son apparition parce que la main d'oeuvre qualifiée fait défaut.

Une autre raison, bien sûr, pour avoir recours à la préfabrication, c'est la rapidité avec laquelle doivent être exécutés certains programmes. Beaucoup de métropoles de ces pays à main d'oeuvre inemployée ont des croissances explosives. Main d'oeuvre excédentaire et croissance de métropoles sont d'ailleurs deux phénomènes liés. La main d'oeuvre inoccupée dans les campagnes a tendance à aller vers la grande ville où on espère trouver du travail et où, en tout cas, on ne meurt pas tout à fait de faim. D'où, dans ces métropoles, le besoin de programmes de construction gigantesques, qui doivent être menés à cadence rapide si l'on ne veut pas être constamment dépassé par les événements.

La préfabrication est un moyen d'exécution rapide.

Ces raisons pourraient paraître des raisons un peu théoriques. Il est nécessaire de montrer que l'emploi de constructions préfabriquées est économiquement possible, c'est-à-dire permet de réaliser des logements du type et du coût qui conviennent aux circonstances économiques. Tout le monde sait que la préfabrication et l'industrialisation en général permettent de réaliser le logement social tel qu'on le conçoit en Europe occidentale, mais ces procédés sont-ils applicables aux constructions de standard moins élevé. C'est ce que nous voulons montrer par quelques exemples et quelques chiffres.

Auparavant, disons qu'il faut entendre le mot préfabrication dans un sens très large et le terme "industrialisation" serait sans doute plus exact, car il convient, dans le sujet qui est le nôtre, d'assimiler complètement le coulage rationnel du béton sur chantier à la préfabrication.

Parmi les constructions les meilleur marché qui ont été réalisées par des procédés industriels, on peut précisément citer les constructions de la Compagnie Immobilière Franco-Marocaine réalisées par coulée, en une seule fois, de toutes les parois d'une pièce.

Un autre système de préfabrication, cette fois-ci exécution de grands éléments préfabriqués sur le chantier, a été utilisé en Algérie. Les plaques minces de béton étaient fabriquées selon la technique de l'empilage, un élément servant de fond de moule à l'élément suivant séparé par une couche de papier craft. Les éléments ont la dimension de la paroi d'une pièce, leur poids est de l'ordre d'une tonne et ils peuvent être manipulés par une petite grue automobile.

Ces constructions étaient du même type que celles qui conviennent à une famille dont le revenu est égal au minimum vital (qui est de l'ordre de 30 à 40 dollars, de manière assez générale par mois). Le prix représente environ 2 ans 1/2 de salaire au niveau du minimum vital.

Les procédés de construction industrialisés utilisés dans les pays d'Europe permettent de réaliser des logements sociaux dont le coût correspond à 2 ans 1/2 d'un salaire de l'employé ou de l'ouvrier qualifié.

Ces éléments sont transposables dans les pays où le prix de la main d'oeuvre est meilleur marché, car contrairement à ce qu'on croit couramment, le coût des investissements nécessaires à la création d'une usine de préfabrication ou d'un outillage spécial, est relativement très peu élevé par rapport aux investissements dans d'autres industries : pour une unité capable de produire 1000 logements/an, les investissements sont de l'ordre de grandeur de 1 millions de dollars, c'est-à-dire si on amorti l'usine sur 5 années ou, autrement dit, sur 5000 logements, 200 dollars par logement.

Cette partie du prix risque de ne pas être diminuée dans le cas d'une installation en pays à main d'oeuvre bon marché, car elle fera intervenir des spécialistes et sans doute aussi quelques importations, mais elle ne représente que 2,5 % du prix du logement.

Par ailleurs, l'essentiel du prix reste formé par la main d'oeuvre et les matériaux. Pour les matériaux, les circonstances sont variées suivant les pays. Dans certains cas, les prix de la plupart des matériaux sont en harmonie avec ceux de la main d'oeuvre. Dans d'autres cas, des matériaux importants comme le bois, le ciment, l'acier sont importés, et sont par conséquent chers, Mais il faut ajouter également que souvent la consistance des équipements de ces logements

sera inférieure à ce qu'elle est dans le logement social européen et souvent même très nettement inférieure. Si bien qu'au total, il ^{est} raisonnable de penser qu'à surface égale le prix d'un logement rapporté au salaire sera du même ordre dans ces pays à main d'oeuvre bon marché et en Europe.

Si l'on ajoute à cela que la superficie de chaque logement sera souvent inférieure à ce qu'exigent les normes européennes, parce que précisément le niveau économique ne permet pas encore d'être aussi généreux, on arrive à cette conclusion que dans les pays à main d'oeuvre bon marché et à faible revenu individuel, la préfabrication permet de réaliser des constructions de logements pour les petits employés et les ouvriers spécialisés.

Considérons, pour terminer que la construction de logements collectifs, selon les procédés traditionnels, serait aussi chère et qu'elle serait souvent irréalisable faute de main d'oeuvre adéquate.



UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

E/CONF.39/D/17

SUMMARY

14 Nov.1962

ENGLISH

ORIGINAL : FRENCH

SUMMARY

Agenda Item: D.14

France

POSSIBILITIES OF PREFABRICATION
IN COUNTRIES WHERE MANPOWER IS CHEAP

By G. BLACHERE

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.
3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.
4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

POSSIBILITIES OF PREFABRICATION IN COUNTRIES WHERE
MANPOWER IS CHEAP

By
G. BLACHERE

The reason for the development of prefabricated housing in France, and now in various countries of Western Europe was the wish to economise in manpower. It is now accepted that construction by prefabrication cannot find its application in countries where manpower is of low cost.

2. In reality, prefabrication not only economises on manpower but requires a different training: it replaces the specialized workers in the traditional trades with builders of engines and motors.

3. In many countries where manpower is cheap, skilled labour is nevertheless in insufficient quantity to ensure the carrying out of a needed housing programme. Rather than train this skilled labour force, the use of prefabrication is preferred.

4. On the other hand, in many countries where manpower is cheap, there is a very rapid development of large centres of population, therefore of highly concentrated and important construction requirements.

5. Often, in such cases, only prefabrication can solve the problem.

